

## **CLAIMS**

- 1    1.    A magnetic head comprising:  
2            a read sensor including a free magnetic layer;  
3            the magnetic head also including a hard bias structure being disposed in side  
4 regions located at side edges of said free magnetic layer;  
5            said hard bias structure including a seed layer and a hard bias layer;  
6            wherein said free magnetic layer has a midplane thereof, and said hard bias layer  
7 has a midplane thereof, and wherein said free magnetic layer midplane and said hard bias  
8 layer midplane are approximately coplanar.
  
- 1    2.    A magnetic head as described in claim 1 wherein said hard bias layer is deposited  
2 next to side edge portions of said free magnetic layer.
  
- 1    3.    A magnetic head as described in claim 1 wherein said seed layer has a thickness  
2 of approximately 5-40 nm and said hard bias layer has a thickness of approximately 5-30  
3 nm.
  
- 1    4.    A magnetic head as described in claim 1 wherein said seed layer has an upper  
2 surface that has been ion milled.

1 5. A magnetic head as described in claim 1 wherein said seed layer is comprised of a  
2 first seed layer portion and a second seed layer portion, where said first seed layer portion  
3 has an ion milled upper surface upon which said second seed layer portion is disposed.

1 6. A magnetic head as described in claim 5 wherein said second seed layer portion is  
2 approximately 4-10 nm thick.

1 7. A magnetic head as described in claim 5 wherein portions of said second seed  
2 layer are disposed against side edge portions of said free magnetic layer.

1 8. A magnetic head comprising:  
2 a bottom magnetic shield layer ( $S_1$ );  
3 a bottom insulation layer ( $G_1$ );  
4 an antiferromagnetic pinning layer being fabricated above said  $G_1$  layer;  
5 pinned magnetic layers being fabricated above said antiferromagnetic pinning  
6 layer;  
7 a spacer layer being fabricated above said pinned magnetic layers;  
8 a ferromagnetic free magnetic layer being fabricated above said spacer layer, said  
9 free magnetic layer having a midplane thereof;

10 a cap layer being fabricated above said free magnetic layer;  
11 a top insulation layer ( $G_2$ ) being fabricated above said cap layer;  
12 a top magnetic shield layer ( $S_2$ ) being fabricated above said  $G_2$  layer;  
13 a hard bias structure being fabricated upon portions of said  $G_1$  layer, said hard  
14 bias structure including a seed layer and a hard bias layer, and wherein said hard bias  
15 layer has a midplane that is disposed at a horizontal level within the magnetic head that is  
16 approximately coplanar with said midplane of said free magnetic layer.

1 9. A magnetic head as described in claim 8 wherein said hard bias layer is deposited  
2 next to a side edge portion of said free magnetic layer.

1 10. A magnetic head as described in claim 9 wherein said seed layer has a thickness  
2 of approximately 5-40 nm, and wherein said hard bias layer has a thickness of  
3 approximately 5-30 nm.

1 11. A magnetic head as described in claim 10 wherein said seed layer has an upper  
2 surface that has been ion milled.

1 12. A magnetic head as described in claim 10 wherein said seed layer is comprised of  
2 a first seed layer portion and a second seed layer portion, where said first seed layer  
3 portion has an ion milled upper surface upon which said second seed layer portion is  
4 disposed.

1 13. A magnetic head as described in claim 12 wherein said second seed layer portion  
2 is approximately 4-10 nm thick.

1 14. A hard disk drive including a magnetic head comprising:  
2 a bottom magnetic shield layer ( $S_1$ );  
3 a bottom insulation layer ( $G_1$ );  
4 an antiferromagnetic pinning layer being fabricated above said  $G_1$  layer;  
5 pinned magnetic layers being fabricated above said antiferromagnetic pinning  
6 layer;  
7 a spacer layer being fabricated above said pinned magnetic layers;  
8 a ferromagnetic free magnetic layer being fabricated above said spacer layer, said  
9 free magnetic layer having a midplane thereof;  
10 a cap layer being fabricated above said free magnetic layer;  
11 a top insulation layer ( $G_2$ ) being fabricated above said cap layer;  
12 a top magnetic shield layer ( $S_2$ ) being fabricated above said  $G_2$  layer;  
13 a hard bias structure being fabricated upon portions of said  $G_1$  layer, said hard  
14 bias structure including a seed layer and a hard bias layer, and wherein said hard bias  
15 layer has a midplane that is disposed at a horizontal level within the magnetic head that is  
16 approximately coplanar with said midplane of said free magnetic layer.

1 15. A magnetic head as described in claim 14 wherein said hard bias layer is  
2 deposited next to a side edge portion of said free magnetic layer.

1 16. A magnetic head as described in claim 15 wherein said seed layer has a thickness  
2 of from approximately 5-40 nm, and wherein said hard bias layer has a thickness of  
3 approximately 5-30 nm.

1 17. A method for fabricating a magnetic head comprising:  
2 fabricating a plurality of thin film layers to create a read sensor, said read sensor  
3 including a first insulation (G1) layer, a pinned layer, a pinning layer, a spacer layer , a  
4 free magnetic layer having a midplane thereof, and a cap layer;  
5 milling said plurality of thin films such that a central sensor region is protected  
6 from milling and unprotected outer regions are milled down to said G1 layer, such that  
7 said free magnetic layer is formed with a central portion and outwardly disposed side  
8 edge portions;  
9 fabricating a hard bias structure upon said G1 layer at said outer regions such that  
10 said hard bias structure is disposed proximate said side edge portions of said free  
11 magnetic layer, said hard bias structure including a seed layer and a hard bias layer, and  
12 wherein said hard bias layer has a midplane that is disposed at a horizontal level within  
13 the magnetic head that is approximately coplanar with said midplane of said free  
14 magnetic layer.

1 18. A method for fabricating a magnetic head as described in claim 17 wherein said  
2 hard bias layer is deposited next to said side edge portions of said free magnetic layer.

1 19. A method for fabricating a magnetic head as described in claim 18 wherein said  
2 seed layer has a thickness of approximately 5-40 nm, and wherein said hard bias layer has  
3 a thickness of approximately 5-30 nm.

1 20. A method for fabricating a magnetic head as described in claim 19 wherein said  
2 seed layer has an upper surface that has been ion milled.

1 21. A method for fabricating a magnetic head as described in claim 19 wherein said  
2 seed layer is comprised of a first seed layer portion and a second seed layer portion,  
3 where said first seed layer portion has an ion milled upper surface upon which said  
4 second seed layer portion is disposed.

1 22. A method for fabricating a magnetic head as described in claim 21 wherein said  
2 second seed layer portion is approximately 4-10 nm thick.